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The quantified histograms: detection of the hidden unsteadiness

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Abstract

For a given level of digitization, a number of relative frequencies presented by a histogram constructed for a short sample (defined as a segment of a random series), related in a certain way to both the length of the sampling (L) and the number of decompositions (K), may form a set of some levels possessing a discrete spectrum. This spectrum can be defined as a *quantified histogram* (QH). The structure of parameters of a certain QH can be analyzed via both the number of quantum levels (NQL) and the proper collection of relative frequencies on every level. These parameters form kind of specific fingerprints, which characterizes statistical properties of the segment of random series. Treated in this way, QHs allow us to introduce the concept of a *standard noise* (SN), which can be used as a noise "ruler" to compare random series of distinct nature. This standard noise turns out to be very useful in the detection of both a hidden unsteadiness and superweak signals existing in random series. In the capacity of an example of the application of this new method, a comparison of statistically sensible distinctions between noises accompanying either earthquakes or technogenic explosions is given. Distinctions thus obtained (called earthquake forerunner) can be used for earthquakes' forecasting.

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Keywords: Complex systems; Quantified histograms; Hidden unsteadiness; Standard noise and weak signal detection; Earthquake and technogenic seismic activity

1. Introduction

In the present time complex statistical systems are subject to an intensive study [1–19]. They are characterized by strong nonlinearity and nonstationarity at either

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